

CHAPTER 4

INNOVATION IN THE MANUFACTURING SECTOR

4.1 Introduction

In the Third Outline Perspective Plan of Malaysia (OPP3: 2001-2010), the manufacturing sector continues to be targeted as one of the main stimulus for economic growth in the country. However, in line with the country's aspirations to shift from the old 'production' economy to the new knowledge-based economy, the manufacturing sector is also expected to move on to a new phase of industrial development. In turn, this new phase of industrial development requires the manufacturing sector to move out of "low-technology" production into "high-technology" production. This shift is crucial for the sustainability of the manufacturing sector as it is confronting an increasingly competitive external environment due to the progressive global liberalisation of trade and investment.

As the manufacturing sector moves forward to embrace this shift, clearly the old assembly-type operations will have to be replaced by new production operations that will enable Malaysia to move up the value-added chain in the production process. Consequently, the new production operations have to be grounded on new production techniques and new production processes. At the same time, new products will have to be generated that can meet the demand of increasingly discerning consumers, both at home and abroad. In other words, companies in the manufacturing sector will have to innovate or exit the industry. Without innovation in today's complex, knowledge-intensive, globalised environment, the products produced by the manufacturing sector in Malaysia can be easily displaced by cheaper and better products from other countries, and not just in the home market but also in the export market. Consequently, innovation holds the key for the future of the manufacturing sector in this country. This chapter aims to provide an insight into the innovation activities that are carried on by the companies in the manufacturing sector for the reference period 2000/2001.

4.2 Profile of Innovating Companies

In this chapter, innovating companies are defined as companies that have successfully introduced new products or improved products or improved technological processes in their production system for the reference period 2000/2001. The definition also includes companies that have projects in progress that are expected to yield innovation in the future.

In the 2000/2001 survey, it was found that 263 companies reported some form of innovation activities. Figure 4.1 shows the sectoral distribution of these 263 innovating companies. Food Products and Beverages is the sub-sector within manufacturing that had the largest number of innovating companies (35 companies or 13.3% of the total number of innovating companies). This is followed by the publishing, printing and reproduction of recorded media industry (30 companies or 11.4 % of the total) while wearing apparel, dressing and dyeing of fur is the sub-sector with the third largest number of innovating companies (29 companies or 11.0% of the total). Fabricated metal products is the fourth largest industry in terms of the number of innovating companies (28 or 10.6% of the total).

There are 5 industries with a range of 10-20 innovating companies each (or 7.6% to 4.6% of the total). These are the manufacture of rubber and plastic products; the manufacture of chemical and chemical products; and the manufacture of other non-metallic mineral products and the manufacture of furniture, n.e.c.; as well as the manufacture of electrical machinery and apparatus, n.e.c. Industries with a range of 3-9 innovating companies each are the manufacture of motor vehicles, trailers and semi-trailers; radio, television and communications equipment and apparatus; textiles; office, accounting and computing machinery; wood and products of wood and cork; basic metals; the manufacture of paper and paper products; machinery and equipment n.e.c; medical, precision and optical instruments, watches and clocks as well as the manufacture of other transport equipment.

At the other end of the spectrum, the two industries with the smallest number of innovating companies are the recycling industry and the manufacture of coke, refined petroleum products and nuclear fuel (with 1 innovating company each or 0.4% of the total for each of these industries). The manufacture of luggage, handbags, saddlery, harness and footwear and the tobacco products industry are the 2 industries with the second smallest number of innovating companies (2 each or 0.8% of the total for each of these industries).

In terms of their geographical distribution, the top four states that hosted the largest number of innovating companies are Selangor (130), Kuala Lumpur (68), Penang (20) and Johor (11) (see Figure 4.2). This is not surprising as these states are also the centre of manufacturing activities in the country. As a corollary to that, the states in Malaysia that have a lower level of industrial activities have a significantly smaller number of innovating companies. Thus, there are only 2 innovating companies in Kelantan on the East coast of the Peninsular, and 1 innovating company each in Perlis, and in Terengganu on the East coast as well as in Sabah and Sarawak in East Malaysia.

FIGURE 4.1: INNOVATING COMPANIES BY INDUSTRY

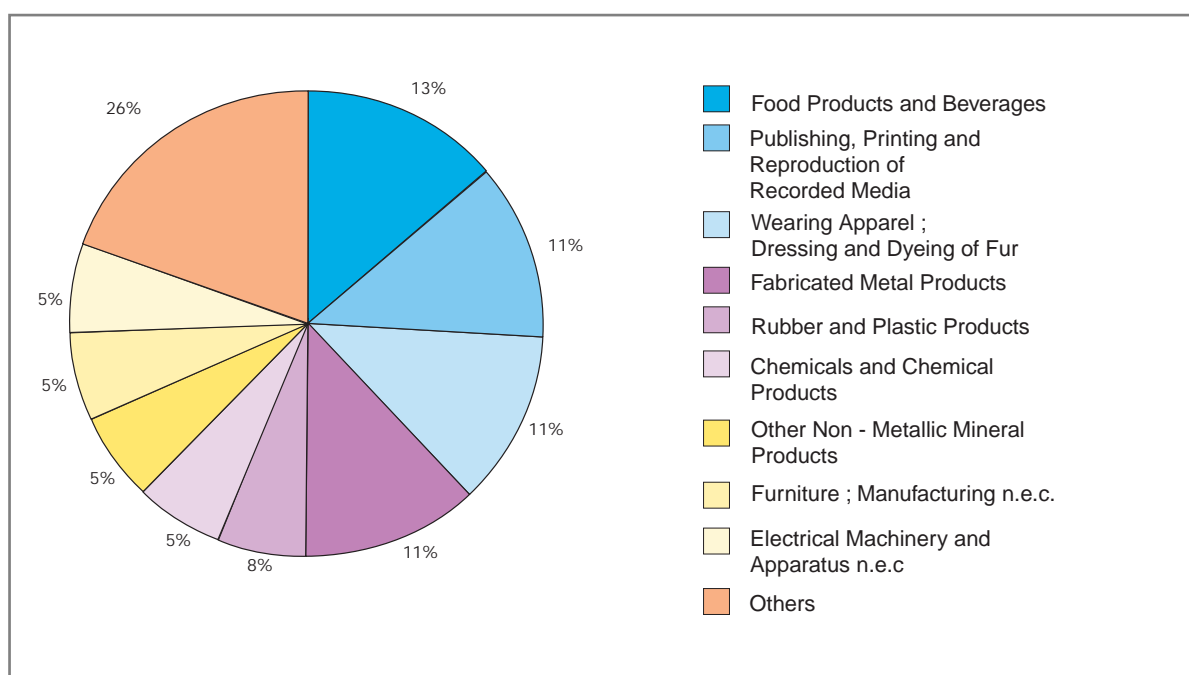
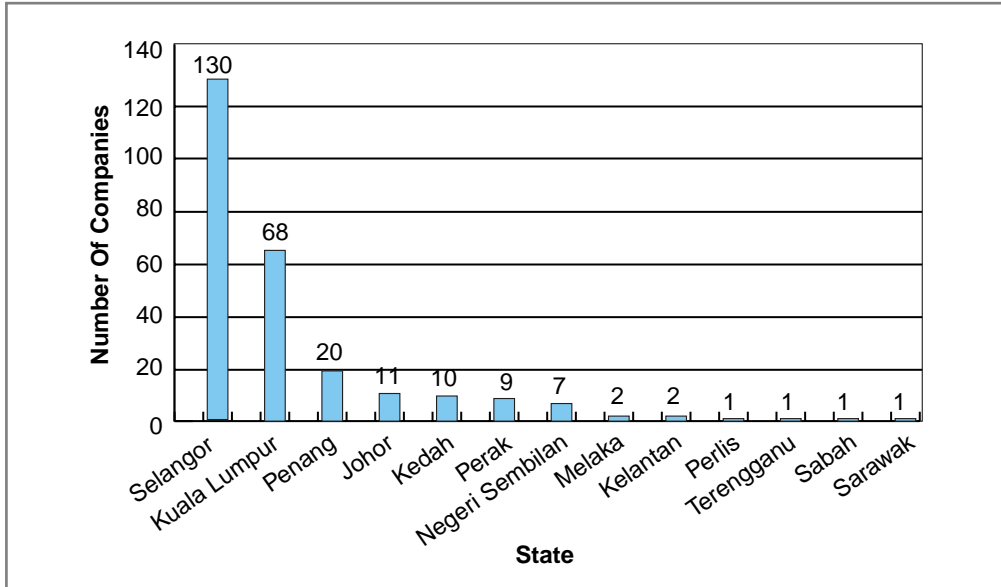
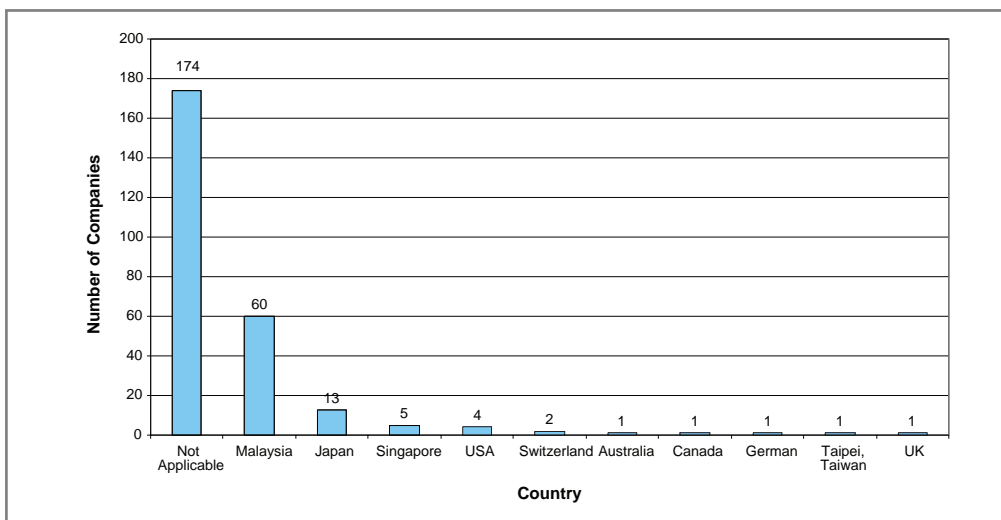


FIGURE 4.2: INNOVATING COMPANIES BY LOCATION



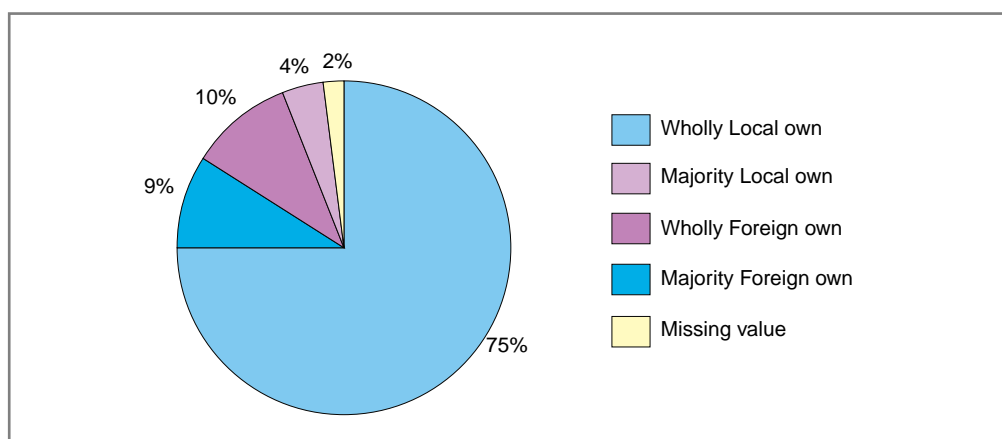
Based on Figure 4.3, it can be seen that 174 of the innovating companies (or 66.4% of the total number of innovating companies) are not subsidiaries of another company. Out of the other 88 innovating companies that reported being subsidiaries of another company, 59 have their headquarters in Malaysia. For the rest, 13 innovating companies reported having their headquarters in Japan, while 5 have their headquarters in Singapore. This is followed by USA (4 innovating companies) and Switzerland (2 innovating companies). Each of the rest of the innovating companies, respectively, reported having their headquarters in Australia, Canada, Germany, Taipei, Taiwan and the U.K.

FIGURE 4.3: INNOVATING COMPANIES BY NATIONALITY



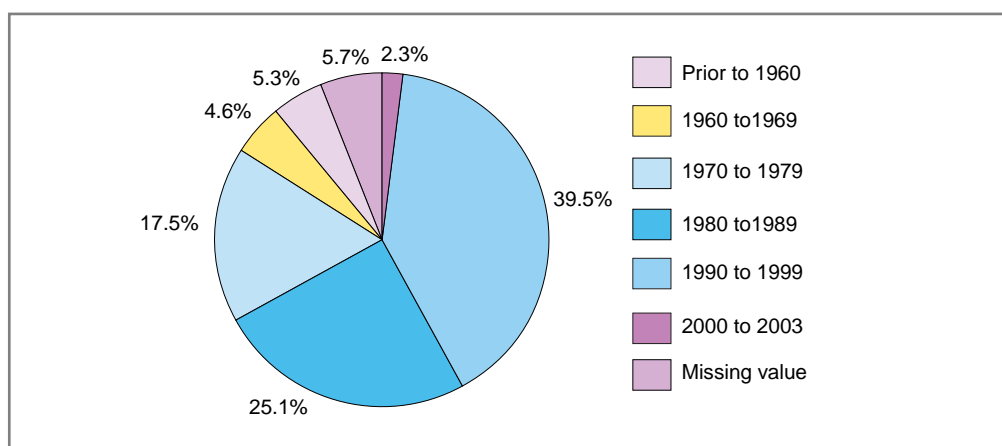
The ownership structure, as shown in Figure 4.4, reveals 198 or 75% of the total number of innovating companies to be wholly locally-owned companies, while 23 (or 9%) are majority locally-owned companies. On the other hand, 26 are wholly foreign owned (or 10%) and 10 (or 4%) are majority foreign-owned. This finding augurs well for Malaysian manufacturing as the participation of Malaysian owned companies in innovating activities is higher than that found for foreign-owned companies.

FIGURE 4.4: INNOVATING COMPANIES BY OWNERSHIP STRUCTURE



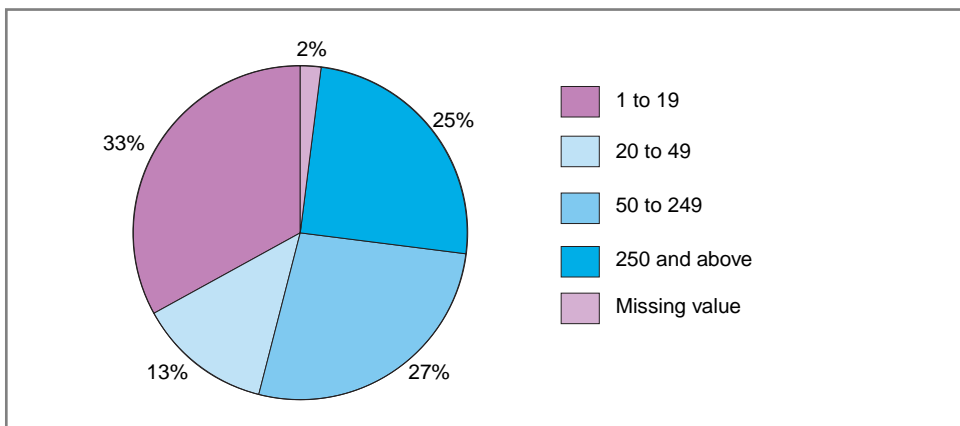
By vintage, the majority of the innovating companies (104 or 40.0% of the total number of innovating companies) were established between years 1990-1999 (Figure 4.5). The results of the survey indicate a progressive decline in the number of innovating companies as the year of establishment is moved further back in time. Thus, 66 of the innovating companies (or 25% of the total number of the innovating companies) were established between years 1980-1989, 46 (or 17% of the total number of innovating companies) were established between years 1970-1979 and only 12 (or 5% of the total number of innovating companies) were established between years 1960-1969. About 14 of the innovating companies reported their year of establishment to be prior to 1960 while only 6 reported that they were established between 2000-2003.

FIGURE 4.5: INNOVATING COMPANIES BY AGE



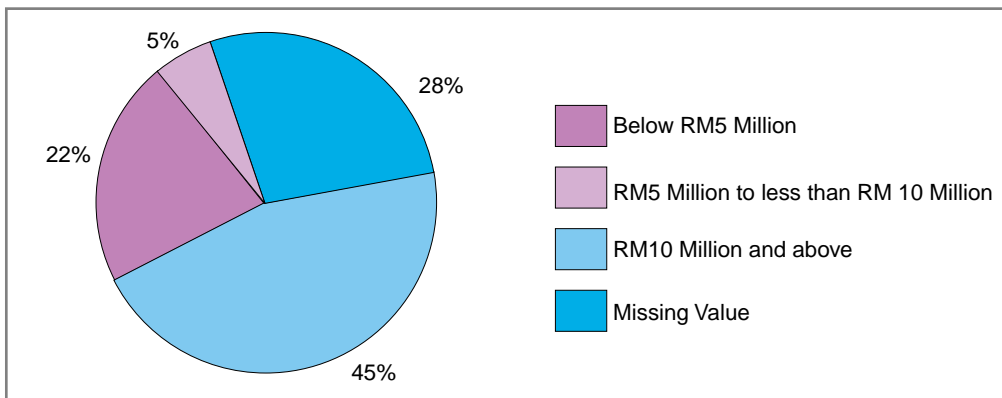
This chapter uses 2 criteria to assess the size of the innovating companies. In terms of employment, the largest number of innovating companies has an employment size of 1-19 (85 companies or 32% of the total number of innovating companies, as shown in Figure 4.6). The next largest number of innovating companies is found in the employment size of 50-249 (72 companies or 27%) while 66 (or 25%) of the innovating companies have an employment size of 250 and above. The smallest number of innovating companies is found in the employment size of 20-49 (34 companies or 13%). Hence, it would appear that smallness in terms of employment size is not a constraint to innovating activities.

FIGURE 4.6: INNOVATING COMPANIES BY EMPLOYMENT SIZE



By turnover, the largest number of innovating companies is found to have a turnover of RM10 million and above (119 companies or 45% as shown in Figure 4.7). The next largest number of innovating companies is, however, found to have a turnover of less than RM5 million (57 companies or 22%) while the smallest number of innovating companies (14 companies or 5%) are found in the turnover group of between RM5 million to less than RM10 million. Therefore, while financial strength is important as indicated by the large number of companies with a turnover of RM10 million and above, again as shown in the case of employment size, companies are not constrained from innovating when they have a smaller turnover.

FIGURE 4.7: INNOVATING COMPANIES BY TURNOVER



4.3 Innovation: Patterns and Activities

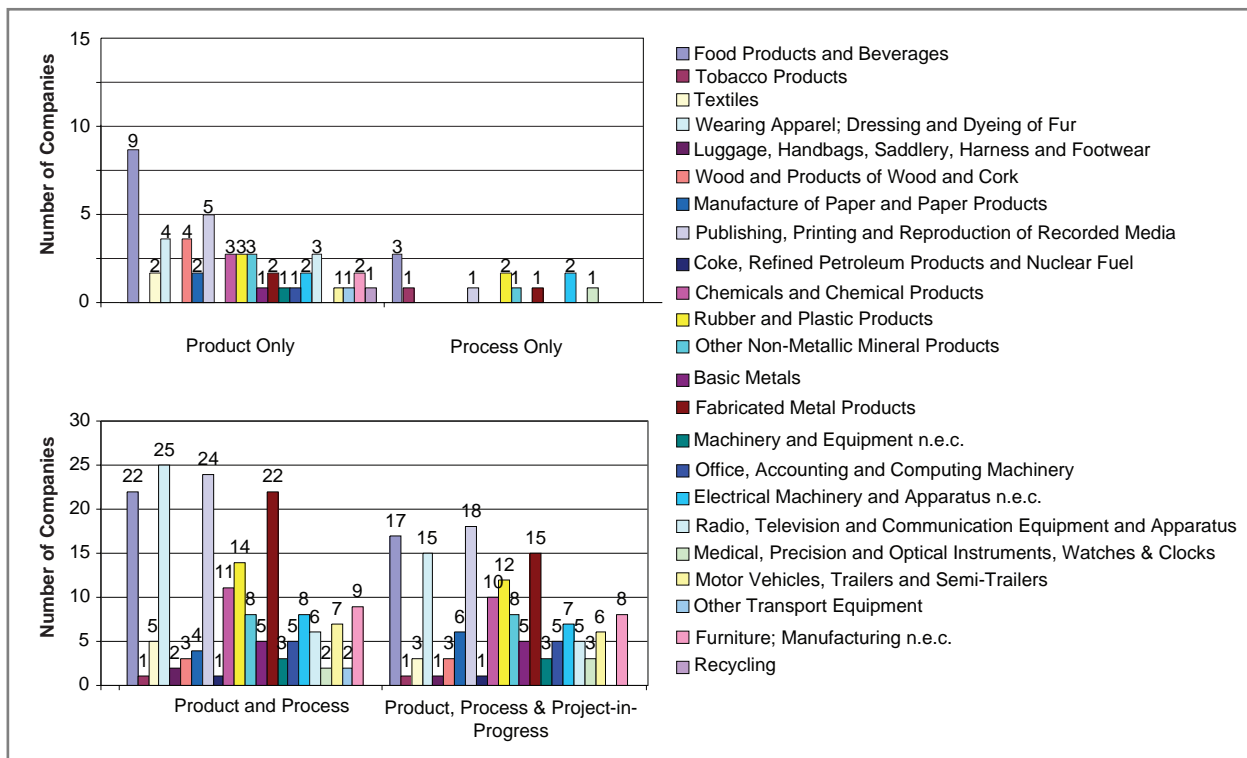
In this section, the typologies of innovation, objectives, sources of information for innovation, innovation cooperation, and government support, incentives and assistance are discussed to facilitate a deeper understanding of the pattern and type of innovation activities that are conducted by the innovating companies found in this survey.

Based on the methodology in the Oslo Manual, two major types of innovation, that is, product and process innovation are examined in this section. Product innovation is defined as the introduction of new and improved products while process innovation is defined as the introduction of new and improved processes. Projects in progress, whether product or process, that are expected to yield either product, process or product and process innovations are also included in the analysis in this section.

Innovation Typology

Based on Figure 4.8, a total of 12 innovating companies reported being involved in process innovation activities, with the food products and beverage sub-sector leading in this area in terms of the number of innovating companies that are involved (3). More innovating companies are involved in product innovation (50) with again the largest number of innovating companies found in the food products and beverage sub-sector (9).

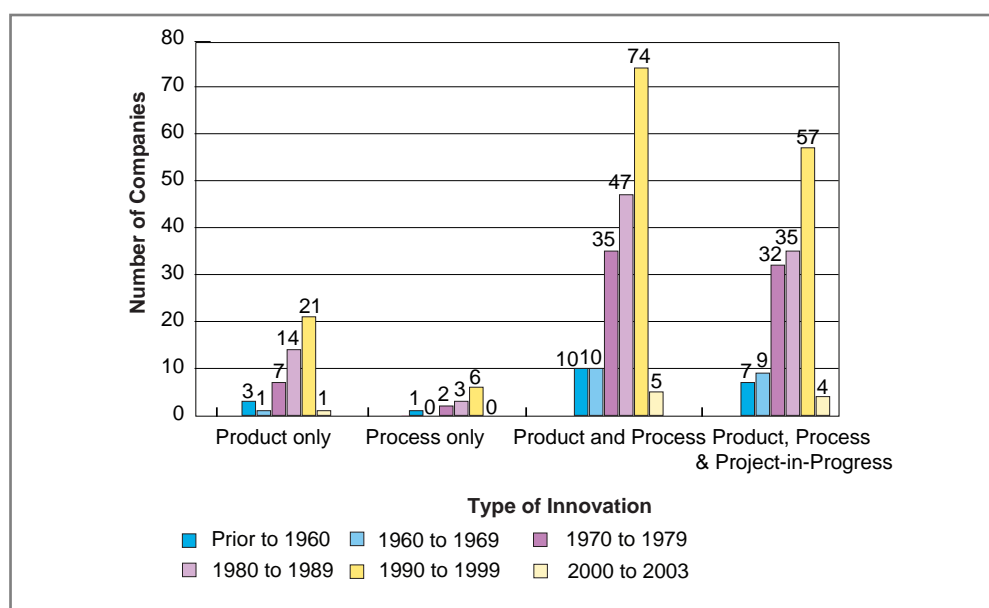
FIGURE 4.8: TYPOLOGY OF INNOVATION BY INDUSTRY



However, the largest number of innovating companies (189) is found to be involved in both product and process innovation. The top four sub-sectors that have the largest number of innovating companies involved in product and process innovation activities are wearing apparel; dressing and dyeing of fur; publishing, printing and reproduction of records; food products and beverage; and the manufacture of fabricated metal products. In addition, a total of 152 innovating companies reported having product and process projects-in-progress. Moreover, it is interesting to note that the top four sub-sectors in terms of having the largest number of innovating companies involved in projects-in-progress are the same as in the case before. The survey evidence therefore indicates the majority of innovating companies in Malaysia are innovating in both products and processes.

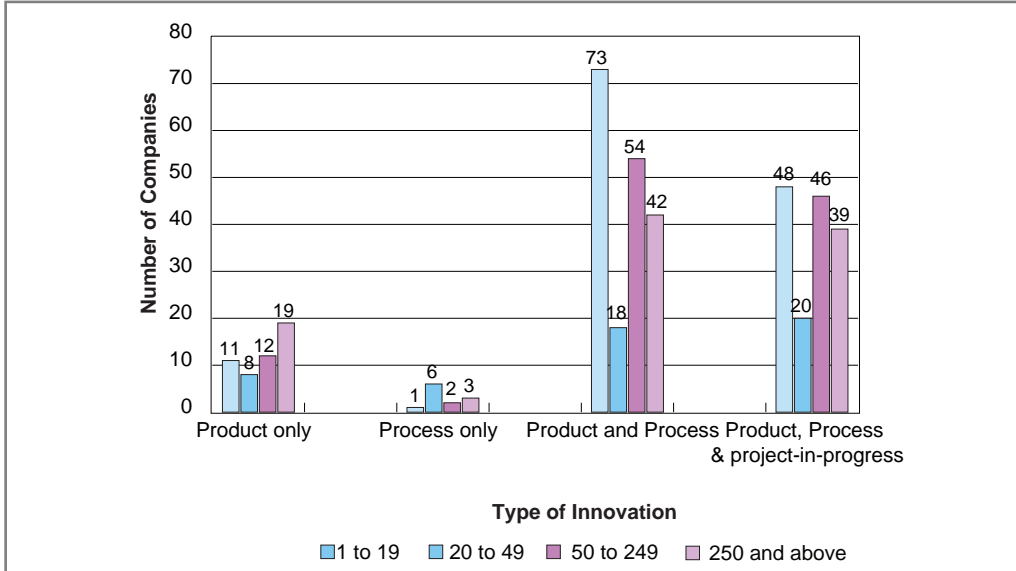
By age, the largest number of innovating companies be it in process, or product, or process and product, or projects-in-progress activities, are found to have been established between 1990-99 (Figure 4.9). Again, there are less companies involved in process, or product, or process and product, as well as projects-in-progress activities, when the year of establishment is shifted further back in time. It would appear that the type of innovation activities do not have a vintage pattern that differs from the overall vintage pattern as explained in the general profile of innovating companies in section 4.2 above.

FIGURE 4.9: TYPOLOGY OF INNOVATION BY AGE



By employment size, in the case of product and process innovation activities and projects-in-progress, the largest number of innovating companies is found in the employment group of 1-19 with the second largest number of innovating companies having an employment group of 50-249 (Figure 4.10). This follows the pattern found in the general profile. However, the largest number of innovating companies in product innovation is found in the largest employment size group of 250 and above, followed by the second employment size of 50-249. In the case of process innovation, the largest number of innovating companies is found in the employment size of 20-49 and the second largest number of innovating companies is in the employment size of 250 and above.

FIGURE 4.10: TYPOLOGY OF INNOVATION BY EMPLOYMENT SIZE



By ownership, regardless of whether it is foreign or local, there are more innovating companies in product and process innovation activities and projects-in-progress activities (Figure 4.11). Wholly local-owned companies as well as wholly foreign-owned companies are also engaged in product only innovation activities and process only innovation activities. On the other hand, both majority foreign-owned companies and majority locally-owned companies are found to be involved in only product innovation but not process only activities.

FIGURE 4.11: TYPOLOGY OF INNOVATION BY OWNERSHIP STRUCTURE

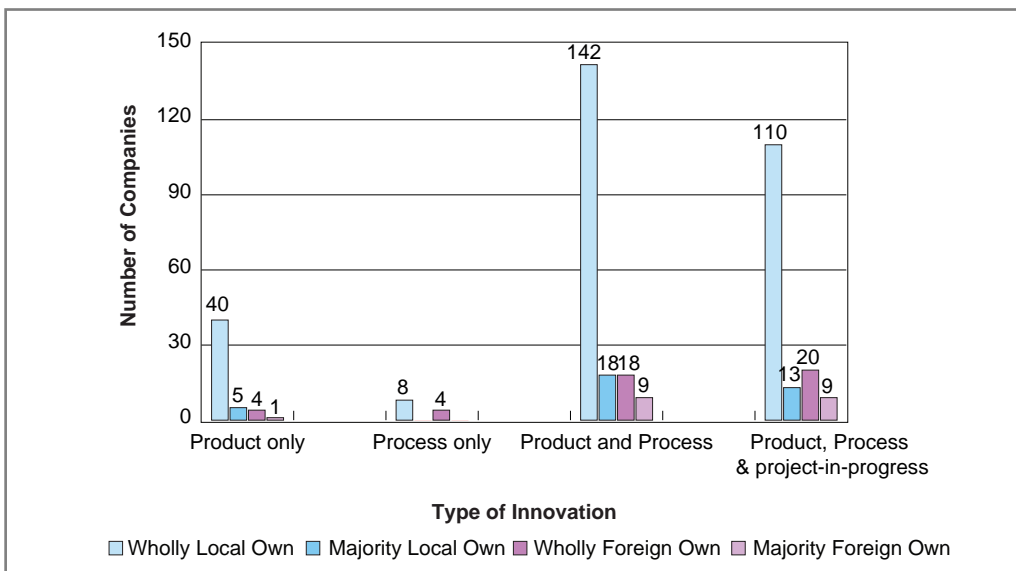
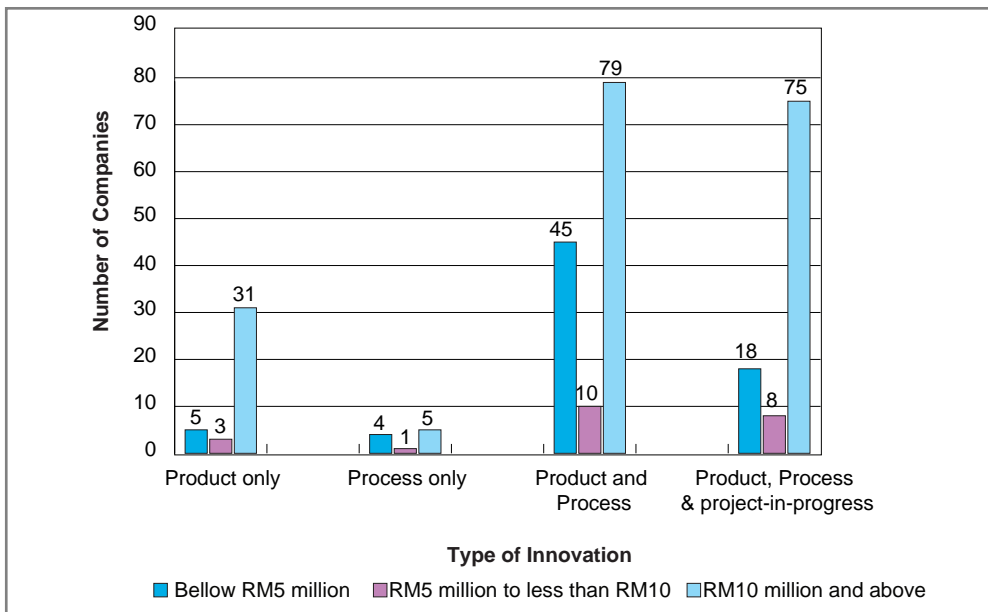


Figure 4.12 shows the distribution of innovating companies by turnover size and the type of innovating activities. The largest number of innovating companies (31 or 79.0%) involved in product only innovation activities is found in large companies in terms of their financial strength (RM10 million and above). Similarly, a larger number of large companies (5 or 50%) in terms of their turnover size (RM10 million and above) is found in process only innovation activities. In terms of the other two types of innovating activities, that is product and process innovation and projects-in-progress,

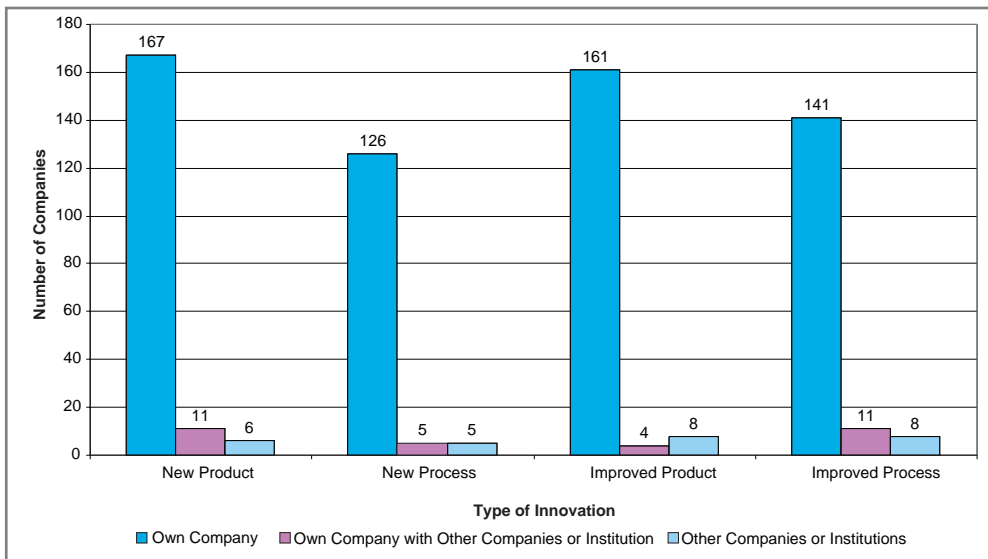
the pattern found conforms to the overall profile explained in section 4.2. Hence, the largest number of innovating companies in each of these 2 types of innovating activities are found in the RM10 million and above group while the second largest number of companies are found with turnover of less than RM5 million.

FIGURE 4.12: TYPOLOGY OF INNOVATION BY TURNOVER SIZE



According to Figure 4.13, an overwhelming number of innovating companies sourced their development, be it in terms of new products or new processes or improved products or improved processes, from within or internally. In contrast, the incidence of innovations being developed jointly together with other companies or institutions or by other companies or institutions is by far much smaller. Thus internal sourcing prevails for all types of innovating activities.

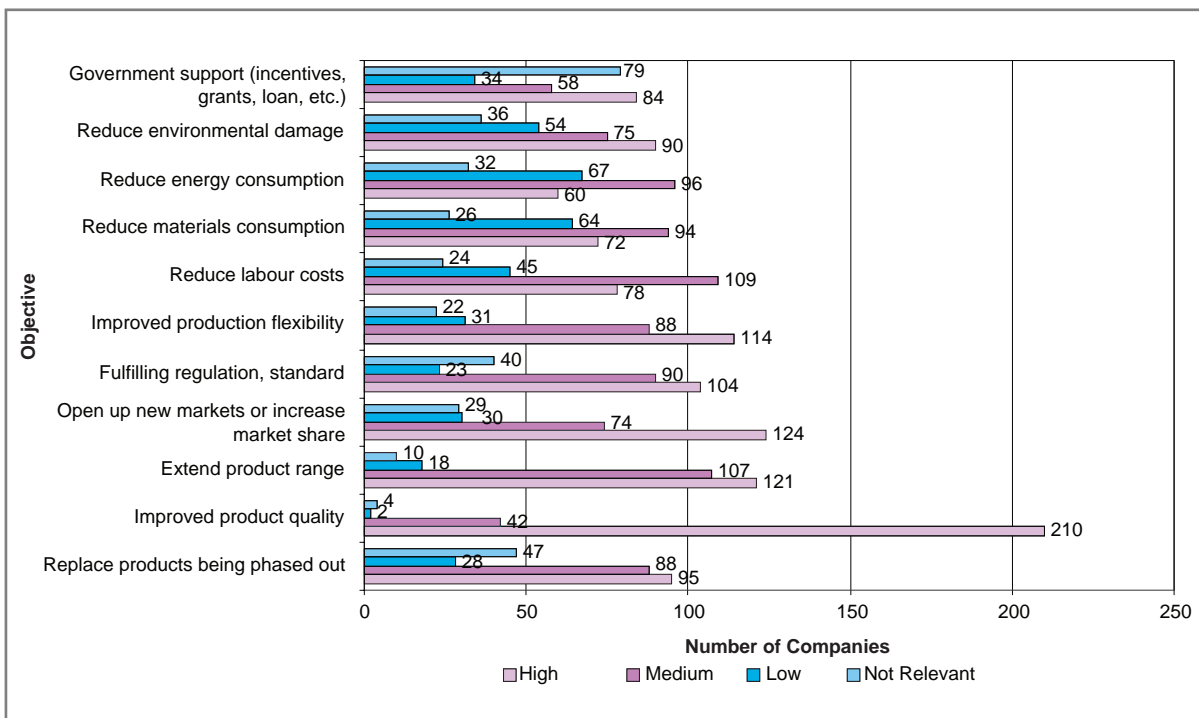
FIGURE 4.13: SOURCE OF DEVELOPMENT FOR NEW AND IMPROVED PRODUCT AND PROCESS



Objectives of Innovation

The motivations for innovation constitute an important component in any innovation survey as this feedback can be used to guide appropriate policy responses. Based on Figure 4.14, the highest response garnered in the high impact group in terms of the number of companies (210 or 81.0% of the total) is found in the need to improve product quality. The other four objectives that had more than 100 companies in the high impact group are to extend the product range, to open up new markets or to increase market share, to improve production flexibility and to fulfil certain regulations or standards. It would appear that the innovating companies are encouraged by market-driven factors to innovate. Reducing energy consumption had the smallest number of firms (60 companies) choosing it as an objective for innovating in the high impact group, followed by reducing materials consumption (72 companies), and reducing labour costs (78 companies).

FIGURE 4.14: OBJECTIVES OF INNOVATION



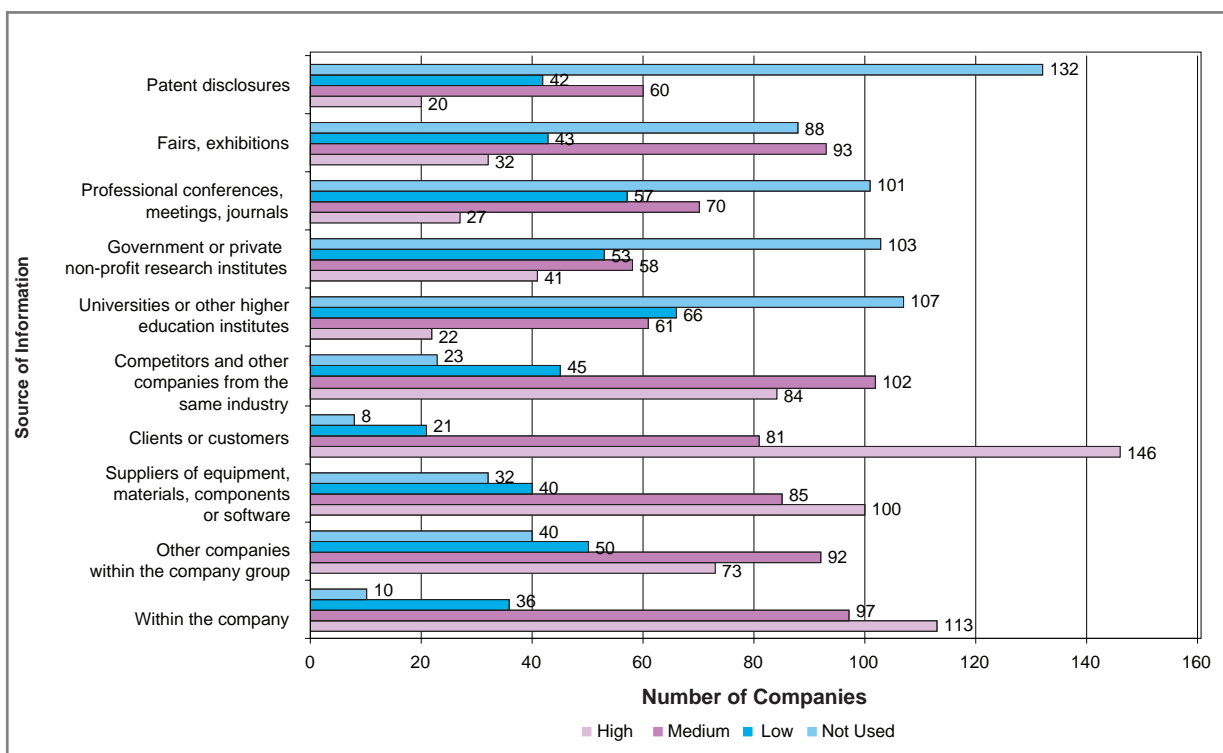
In the group that considers the objectives posed as not relevant, it is interesting to note that the factor that received the largest number of responses from the innovating companies is government support in terms of incentives, grants, loans, etc. (79 companies or 31.0%). This response should be weighed against the 84 innovating companies or 33.0% of the innovating companies that found government support to have a high impact on their involvement in innovation activities. Therefore, government support though important for some, are deemed as completely irrelevant for approximately the same number of other innovating companies. When government support is viewed relative to other factors, it has less than half of those innovating companies that indicated the need to improve product quality as having a high impact on their motivation to innovate. However, only 4 (or 2.0%) of the innovating companies found the need to improve product quality to be irrelevant to their motivation to innovate.

Sources of Information for Innovation

Apart from the motivation for innovation, it is also pertinent to consider the sources of information for innovation, as shown in Figure 4.15. The innovating companies' clients or customers appears to be the most important factor as it had the largest number of companies indicating it to have a high impact on them (146 companies or 57%). This again confirms the previous finding that innovation in the country is market-driven. Other sources of information that have a high impact on the innovating companies are internal sources, suppliers of equipment, materials, etc., competitors and other companies within the group. On the other hand, patent disclosures, and universities, or other higher education institutes appear to have less bearing as sources of information as only a relatively small number of companies indicate these factors as having a high impact on them (less than 10%).

The importance of market-driven sources of information is further confirmed by the relatively small number of companies that indicated that they did not use information from their clients (8 companies), or internal information as sources of information (10 companies). In contrast, patent disclosures had the largest number of companies indicating that it was not used as a source of information (132 or 52%). In addition, 107 innovating companies also revealed that they did not use universities as a source of information, confirming the weak industry-university link in the country. Similarly, there is also an implied weak link between the government or private non-profit research institutes as 103 of the innovating companies did not use them as sources of information. Professional conferences also did not serve as a source of information for 101 of the innovating companies.

FIGURE 4.15: SOURCES OF INFORMATION FOR INNOVATION

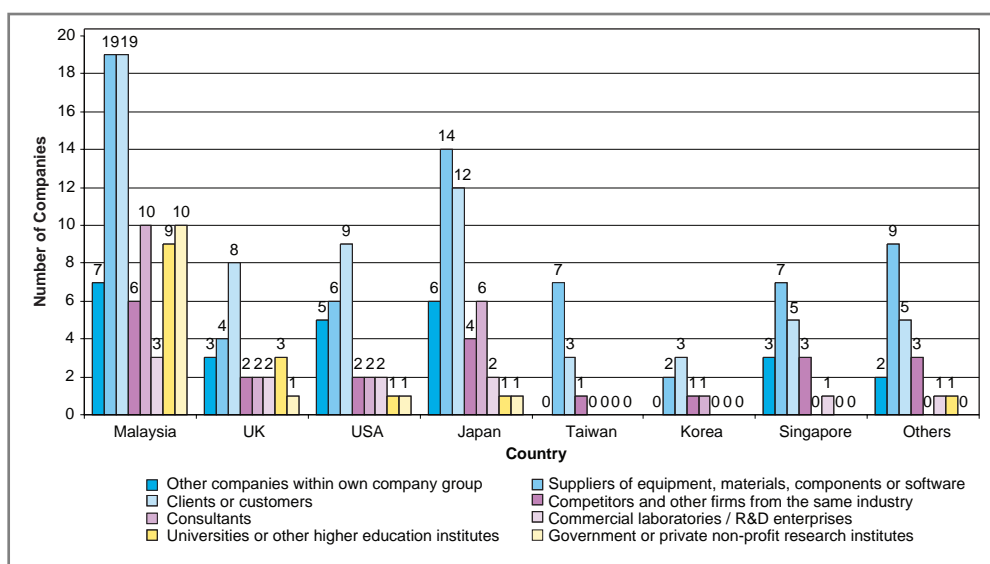


The above findings show that the research conducted at the university and government institutions need to be made more relevant and disseminated more broadly so that the companies in Malaysia can utilise them as sources of information for purposes of innovation.

Co-operation for Innovation

Overall, there are only 55 innovating companies (or 21% of the total number of innovating companies) that reported having co-operation agreements on innovation activities while a significantly larger number of innovating companies reported the converse (204 or 78%). Within Malaysia, the two strongest co-operation for innovation are the clients and suppliers of equipment (19 companies each, based on Figure 4.16). The same pattern is observed for cooperation with foreign partners for all the foreign countries shown in the same Figure.

FIGURE 4.16: CO - OPERATION FOR INNOVATION BY COUNTRY



At the same time, the main foreign partners, being from Japan, USA and UK, appear to follow the main investment partners of the country. This is to be expected as the multinational subsidiaries as well as wholly-owned foreign companies will tend to seek co-operation agreements with their parent or other affiliated companies from their source countries. Since the trade pattern also follows closely to the investment pattern due to the prevalence of intra-firm trade among the multinational companies, it follows that the co-operation agreements also will tend to follow the trade pattern, which in turn is greatly influenced by the investment pattern. Thus the main foreign partners tend to follow both the main investment and trade partners of Malaysia.

With Malaysian partners, co-operation with consultants, universities and government research institutions are the next three most frequently used modes of co-operation for innovation. This is followed by competitors and other firms from within the same industry as well as other companies within their own company group. On the other hand, commercial laboratories/R&D enterprises are less frequently used for

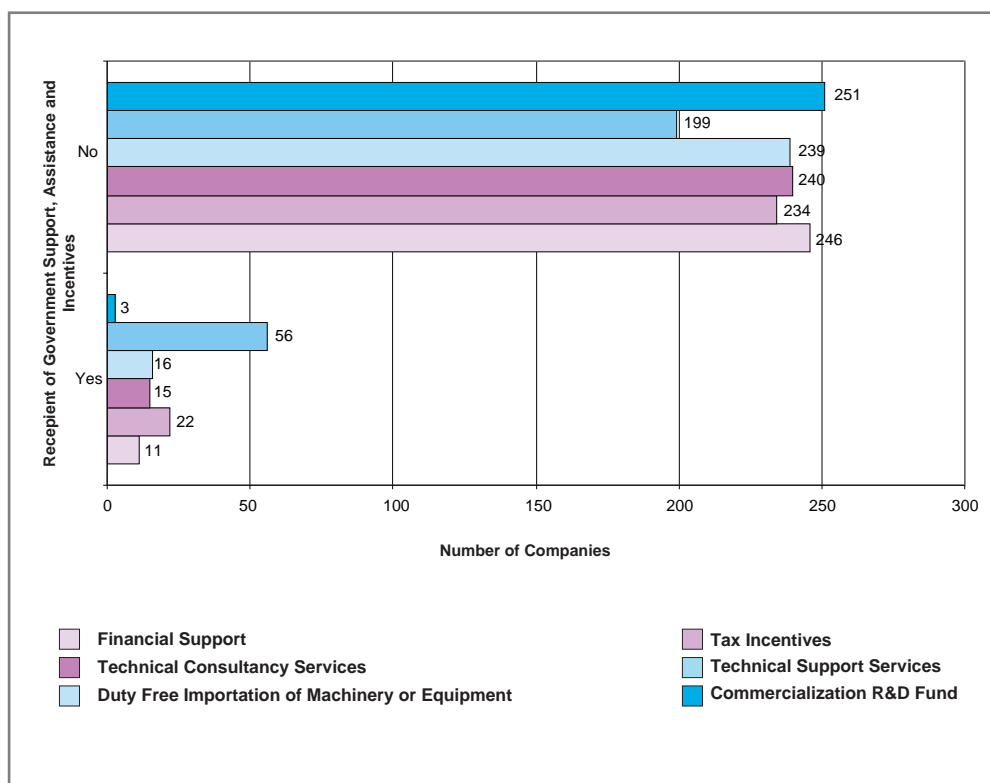
co-operation in innovation. In the case of co-operation with foreign partners, however, other firms within the own group of companies and competitors appear to be more important modes of co-operation than universities and government research institutions. In fact there are more foreign partners reported using commercial laboratories than co-operating with universities and foreign research institutes.

Overall, the finding that clients and suppliers were the major co-operation arrangement indicates that the vertical chain for the creation of value-added, from suppliers and customers, has tremendous potential for innovation.

Government Support, Assistance and Incentives for Innovation

First of all, the number of companies that reported not having received government support and incentives (246 companies or 96%) far exceeds those that confirmed having received government support and incentives (11 companies or 4%, see Figure 4.17). Within the group that reported having received government support, assistance and incentives, duty free importation of machinery or equipment has the largest number of companies (56 companies or 22%), followed by tax incentives (22 companies or 9%). The other forms of assistance enjoyed by the innovating companies are technical support services (16 companies) and technical support services (15 companies). Only three innovating companies are found to have received the commercialisation of R&D fund. In general, the finding in this section indicates a need to investigate further on the effectiveness of government support, assistance and incentives in order to ascertain the bottlenecks in the delivery system as well as to find ways for enhancing the effectiveness of government support.

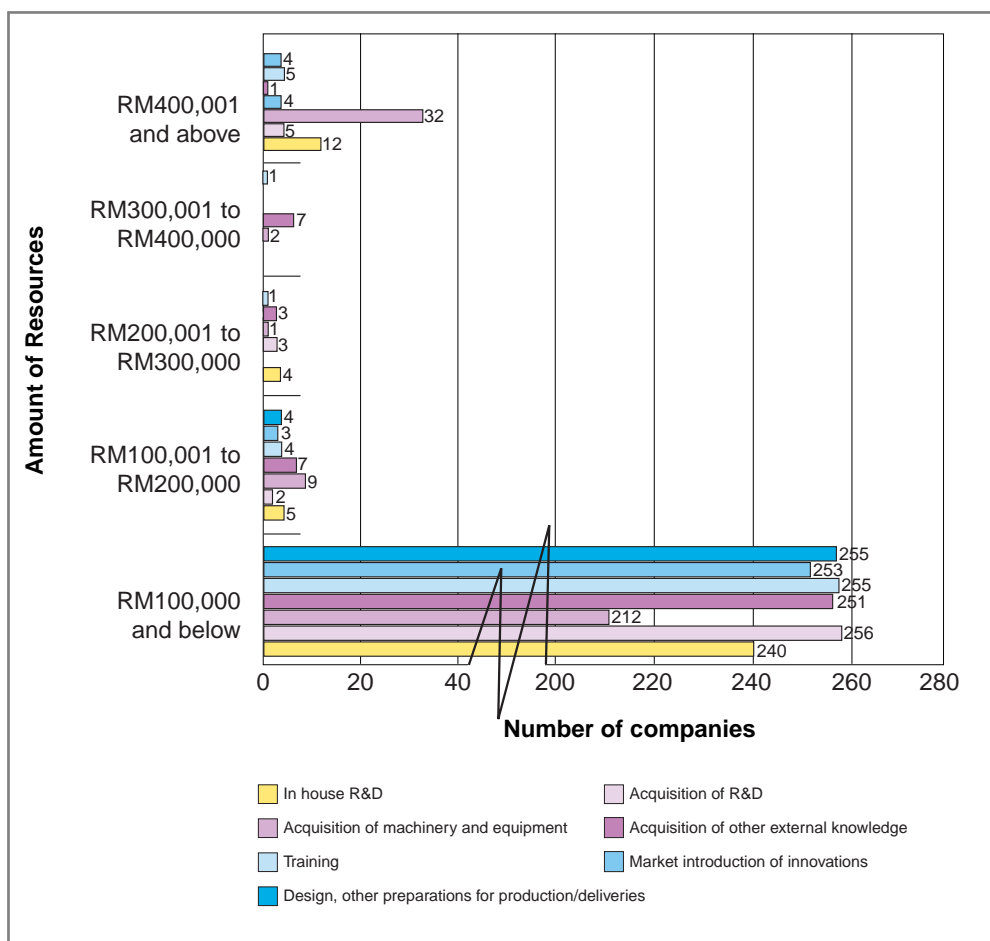
FIGURE 4.17: GOVERNMENT SUPPORT, ASSISTANCE AND INCENTIVE OF INNOVATION



4.4 Resources Devoted to Innovation

In this section, the spending pattern on the different types of innovation activities of the companies is shown in Figure 4.18. First of all, most of the companies reported spending less than RM100,000 or less. Within this group of expenditure, the largest number of companies is found in the acquisition of R&D (256 companies), followed by training (255 companies) and design (255 companies) as well as the market introduction of innovations (253 companies). Second, most of the companies (almost at least 97% of all the innovating companies) reported spending for the acquisition of R&D, training, design, and marketing.

FIGURE 4.18: RESOURCES DEVOTED TO INNOVATION ACTIVITIES BY TYPE OF EXPENDITURE



The smallest number of companies that reported spending within the RM100,000 or less group of expenditure is found in the acquisition of machinery and equipment (212 companies). However, for all the other expenditure groups as shown in Figure 4.18, the emphasis appears to be more focussed on the acquisition of machinery. For example, 32 companies reported allocating RM400,001 and above for the acquisition of machinery and equipment.

The expenditure pattern thus shows that when the amount spent is RM100,000 or less, it is spread over the whole range of innovation activities as shown in Figure 4.18 while the incidence in the larger amount spent appear to be more concentrated on the acquisition of machinery and equipment.

4.5 Impact of Innovation

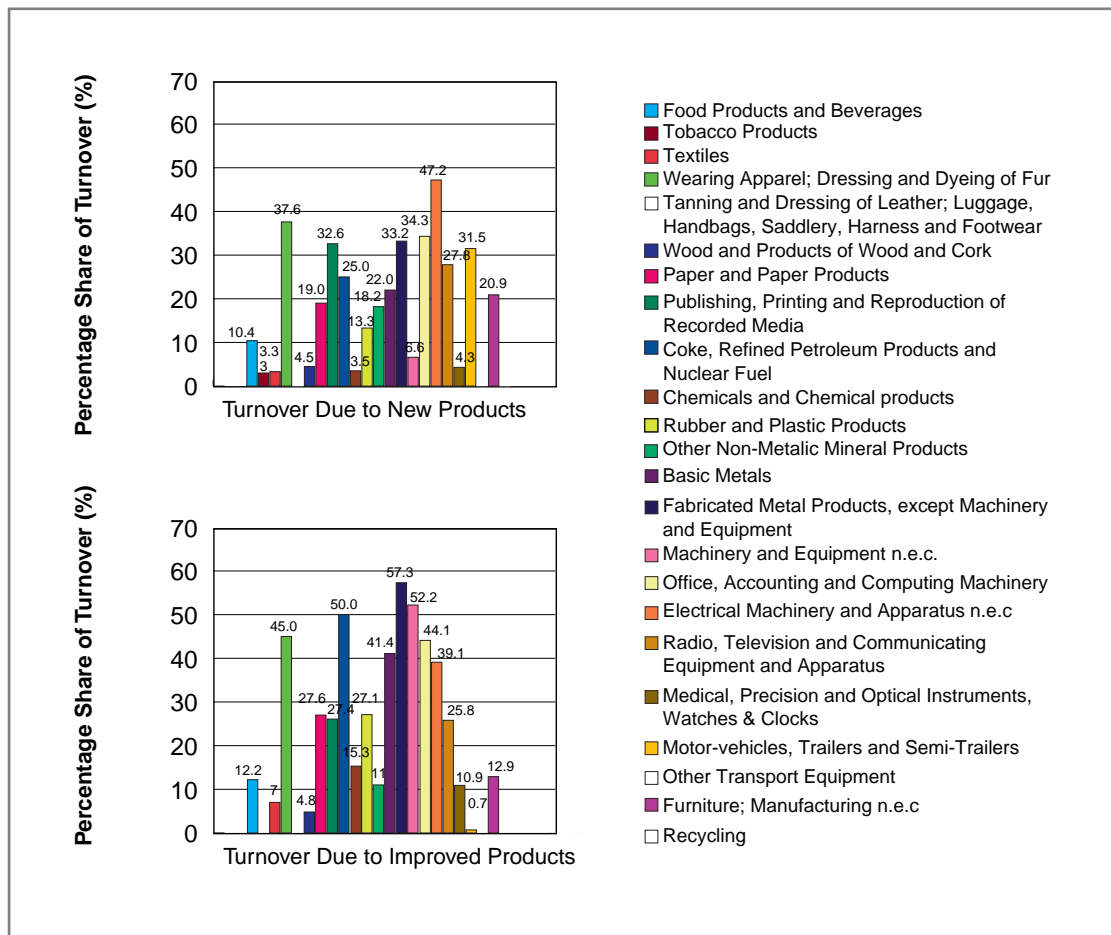
The survey findings on the impact of innovation on firms are presented in this section. Several measures of the impact of innovation on firms are used and they include turnover due to innovation, patent and industrial design, and effectiveness and efficiency factors.

Turnover due to Innovation

Overall, there are significant variations in the impact of innovation on firms' turnover across the different industries (see Figure 4.19). In the case of turnover due to new product, such impact range from as low as 3percent (in the tobacco products) to as high as 47% (electrical machinery and apparatus n.e.c.). The industries that experience very high measure of impact of innovation on turnover for new products include electrical machinery and apparatus n.e.c. (47%), wearing apparel, dressing and dyeing of fur (38%), office, accounting and computing machinery (34%) and fabricated metal products (33%).

The impact of innovation in terms of the turnover attributed to improved products is very similar. Industries with very high impact of new product on turnover include fabricated metal products (57%), machinery and equipment n.e.c. (52%), coke, refined petroleum products and nuclear fuel (50%) and wearing apparel, dressing and dyeing of fur (45%).

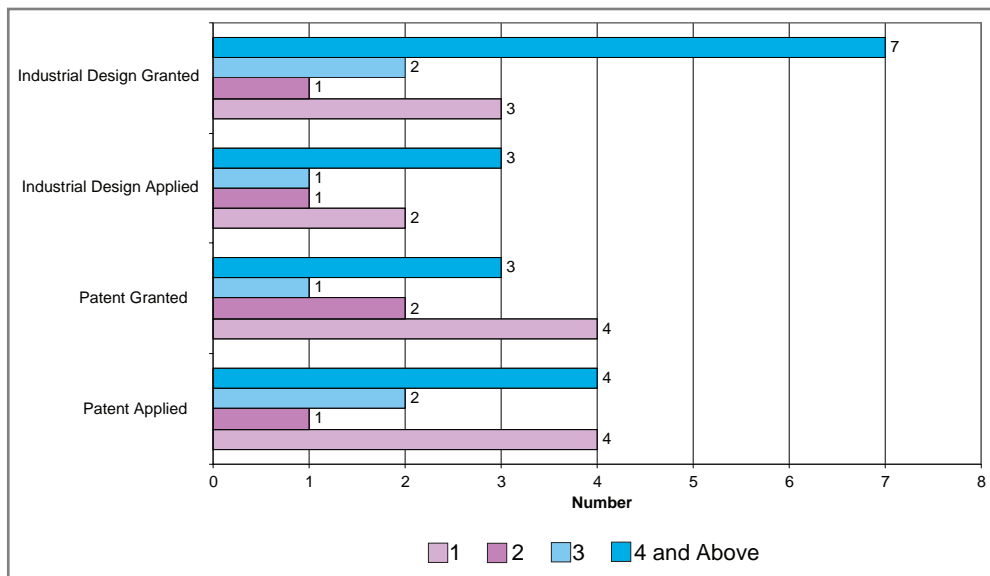
FIGURE 4.19: TURNOVER DUE TO INNOVATION



Patent and Industrial Design

The impact of innovation can also be measured by the number of applications for patents and industrial designs and the numbers granted. Given the coverage of the survey and the number of innovating firms surveyed, the numbers of patent and industrial design applications and grants/approvals are very low (see table 4.20). This finding is very similar to that of the previous innovation survey. Even though the number of industrial design granted exceeds that in the previous innovation survey, the corresponding figure for other categories are either similar or lower than the previous survey.

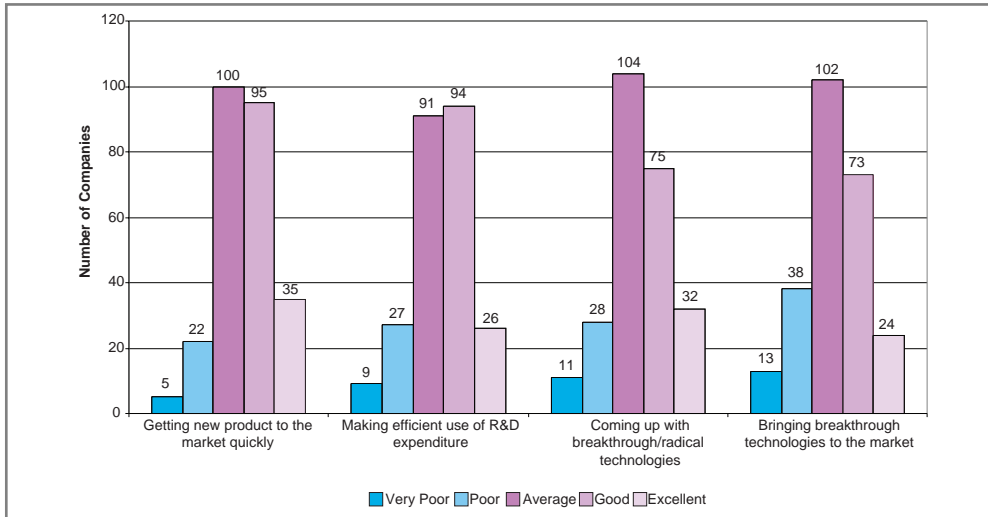
FIGURE 4.20: PATENT AND INDUSTRIAL DESIGN - NUMBER APPLIED AND GRANTED



Efficiency and Effectiveness Measures

The effectiveness and efficiency measures enable us to evaluate the extent to which firms have been able to harness the fruits of innovation in terms of product development, efficient use of R&D, technological breakthrough and commercialization of new technologies. In terms of the two efficiency measures (namely product development and R&D expenditure), the results are very encouraging. The same can be said for effectiveness measures (technological breakthrough and commercialisation of new technologies). These findings are very similar to those in the previous innovation survey.

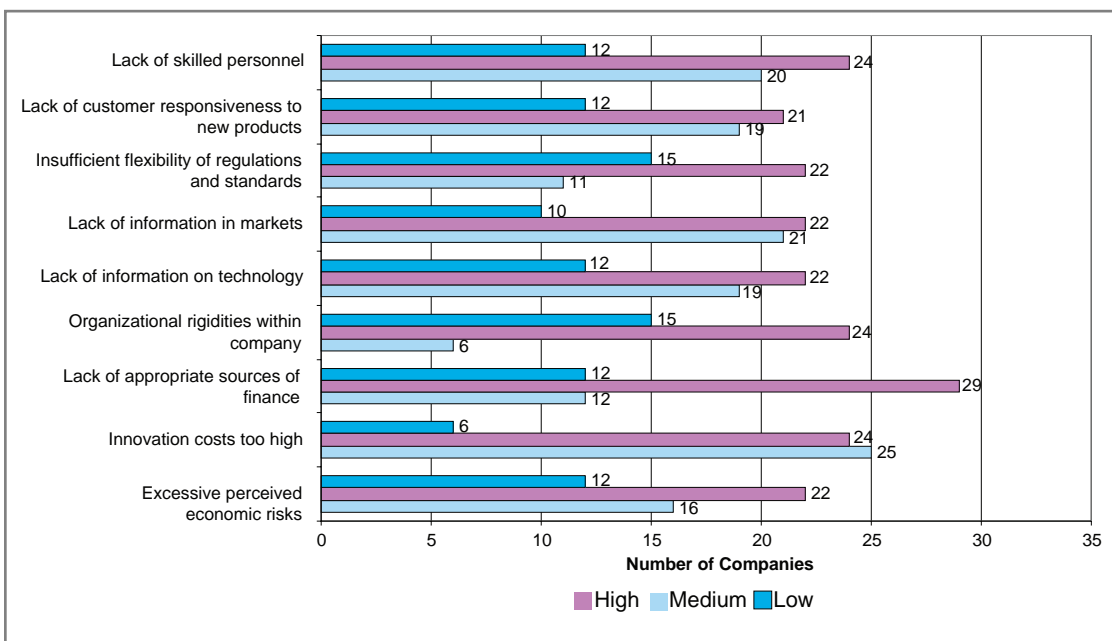
FIGURE 4.21: EFFECTIVENESS AND EFFICIENCY MEASURES



4.6 Factors Hampering Innovation

The major factors hampering innovation are summarized in Figure 4.22. From the survey, the high cost of innovation is probably the most important factor hindering innovation. Lack of skilled personnel, lack of information on technology and lack of market information are also important factors hampering innovation. Other factors that do not seriously hamper innovation include regulatory factors and organisational rigidities. These findings are quite similar to those found in the previous innovation survey.

FIGURE 4.22: FACTORS HAMPERING INNOVATION



4.7 Innovating Firms Longitudinal Data (NIS-2 and NIS-3)

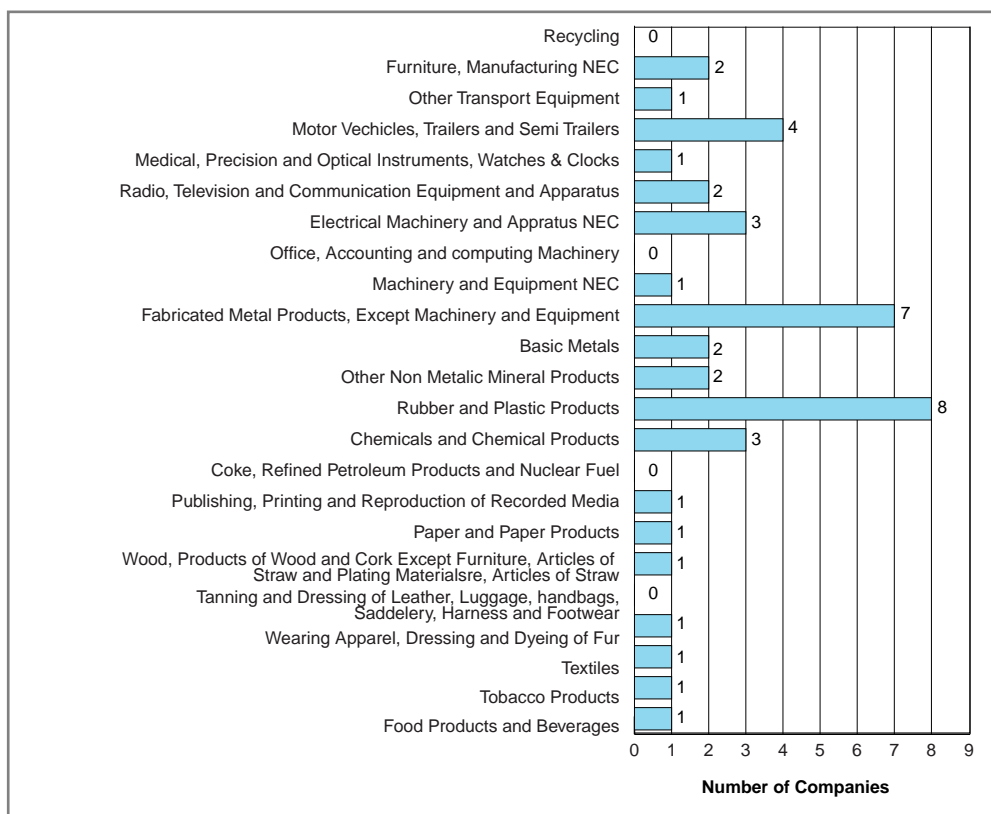
Technological innovation and diffusion are dynamic phenomena. Firms undertake R&D investments in the hope of generating new products and processes in the long run. When these new products and processes emerge, their diffusion in the market and industry takes time. Survey data at a given point in time gives, at best, snapshots of technological innovation and diffusion. The innovation performance of firms over time can be monitored by employing longitudinal data comprising data from two or more survey data.

Of the 263 innovating firms in the present innovation survey (NIS-3), 43 were also innovators in the previous innovation survey (NIS-2). This section compares the various aspects of innovating firms in the NIS-2 and NIS-3.

Sectoral Distribution of Innovating Firms

The pattern of distribution of the 43 firms in the longitudinal data across the various industries is different from that of full NIS-3 survey data set (Figure 4.23). Industries with large representation include rubber and plastic products (8 firms or 19%), fabricated metal products (7 firms or 16%) and motor vehicles, trailers and semi-trailers (4 firms or 9%). Ten out of the 37 industries are represented by one firm each in the data. Four industries are not represented. The longitudinal data is not a good sample representation of the manufacturing sector. Many of the key industries are under-represented while others are over-represented. However, keeping this limitation in mind, some interesting patterns emerge.

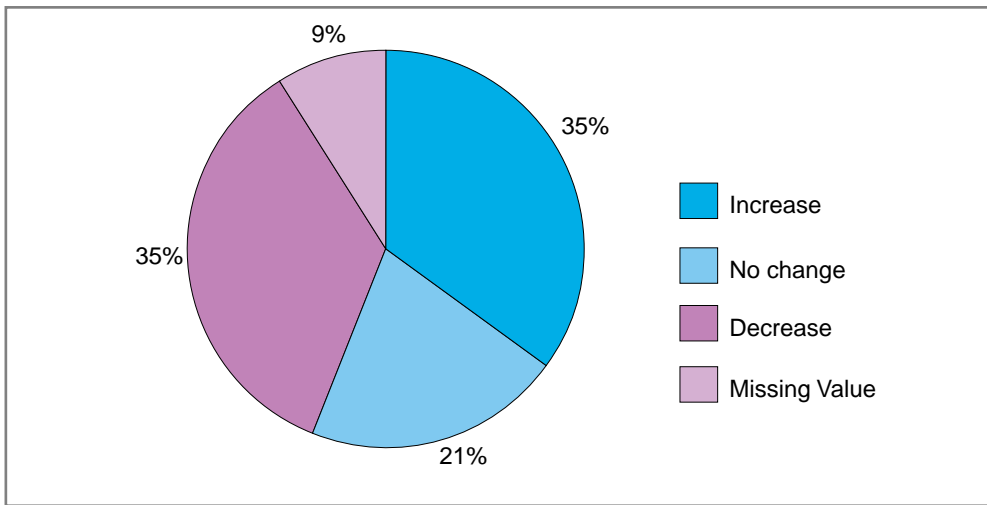
FIGURE 4.23: DISTRIBUTION OF LONGITUDINAL INNOVATING COMPANIES ACROSS INDUSTRIES



Change in Firm Size

Of the 43 innovating firms in the longitudinal data, 15 (or 35%) grew in size (in terms of number of employees) between 1999 and 2001 (see Figure 4.24). The same number of firms (15) experienced a decline in size during this period. Nine firms (or 21%) did not experience any change in size.

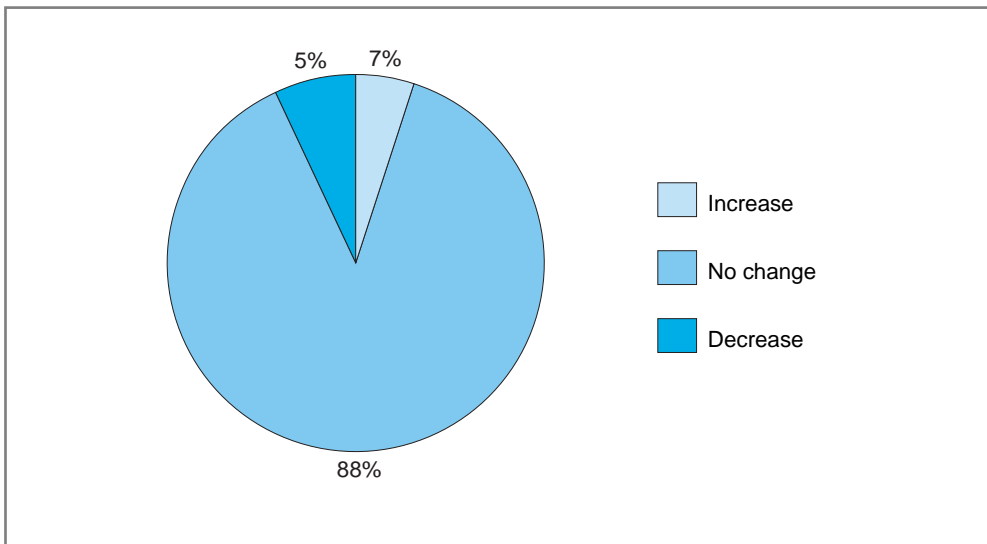
FIGURE 4.24: DIRECTION OF CHANGE IN SIZE OF INNOVATING FIRMS, 1999-2001



Change in the Number of New Products

A total of 38 firms (or 88%) did not increase the number of new products they produce between 1999 and 2001 (see Figure 4.25). Only three firms (or 7%) reported that they have increase the number of new products during the 1999-2001 period. Two innovating firms experience a decline in the number of new products during this period.

FIGURE 4.25: CHANGE IN THE NUMBER OF NEW PRODUCTS OF INNOVATING FIRMS, 1999-2000



Change in Innovation Expenditure

Twenty four (or 56%) of the 43 innovating firms in the longitudinal data did not experience any change in their innovation expenditure during the 1999-2001 period (Figure 4.26). During this period, four firms reported increases in their innovation expenditure while another three reported decline in innovation expenditure.

FIGURE 4.26: CHANGE IN INNOVATION EXPENDITURE OF INNOVATING FIRMS, 1999-2001

